UNIVERSITY OF

CONNECTICUT

COLLEGE OF LIBERAL ARTS AND SCIENCES
Department of Marine Sciences

5/24/97

Dr. Alan Weidemann
Naval Research Laboratory
Stennis Space Center, MS 39529-5004

NRL Grant # N00014-95-I-G909

Dear Dr. Weidemann:

In order to complete my NRL grant entitled "The Influence of Particulate and Dissolved Material on the Water Clarity of the Littoral Zone", I am enclosing the Final Technical Report to you with copies distributed as indicated below.

Sincerely,

Collin Roesler

cc:

Dr. Steven Ackleson
Environmental Optics
Office of Naval Research
Ballston Towers #1
800 North Quincy Street
Arlington, VA 22217-5660

Defense Technical Information Center
Bldg. 5, Cameron Station
Alexandria, VA 22304-6145

Director, Naval Research Laboratory
Attn.: Code 2627
Washington, DC 20375

FINAL TECHNICAL REPORT

NRL GRANT# N00014-95-1-G909

Collin S. Roesler

The Influence of Particulate and Dissolved Material on the Water Clarity of the Littoral Zone

The goals of this project were to quantify the temporal and spatial variations in the optical properties of phytoplankton, tripton and dissolved components in the littoral zones of two different regions. Two experiments were conducted in which water samples were collected simultaneous to in situ profiles of the spectral optical properties (S. Pegau, Oregon State University) and at the sites of moored optical instrumentation (A. Weidemann, NRL). These water samples were analyzed for pigment concentrations and spectrophotometric absorption coefficients (separated into contribution by phytoplankton, tripton, and dissolved components). By separating the total optical coefficients into contributions by various components, the observed variations in optical properties as a function of depth or time can be attributed to one or more of the components. Such analysis allows the variations to be classified as conservative, associated with physical processes (e.g. water mass mixing, passage of internal waves), or non-conservative variations associated with changes in component-specific optical properties (e.g. photoacclimation in phytoplankton, compositional changes in colored dissolved organic matter).

The first experiment was conducted at Eglin Air Force Base, Fort Walton Beach, Florida in March 1995. The sampling area was defined by the a rectangle of approximately 300 m along the shore from the waters edge to approximately 150 m offshore with a water depth of 15 m. The total absorption coefficients at 410 nm were dominated by the dissolved fraction, followed by tripton and then phytoplankton. The largest source of variability in the absorption coefficients was caused by a three day wind storm which resulted in significant increases in wave height, bottom scouring, and mixing. The dissolved absorption coefficients, averaged over the sampling region, increased from approximately 0.12 m^{-1} at 410 nm to over 0.32 m^{-1} after the storm, most likely due to the release of organic-rich pore waters by resuspension of the bottom sediments. Cross shore variability exceeded alongshore variability (standard deviations, σ = 0.02 to 0.2 m^{-1} at 410 nm) and those variations were larger after the passage of the storm. The short term temporal variations (<9 h) were generally less than the spatial variations, of order σ =0.005 to 0.045 m^{-1}. The temporal variations were largest in the offshore stations in 15 m of water compared to the shallower stations. Variations observed over a 15 minute period in the surf zone were comparable to those observed over a nine hour period (σ =0.01 to 0.02 m^{-1} for each component at 410 nm). There was very little variation in the component-specific absorption spectra over the course of the experiment and thus the observed variations were attributed to conservative processes.

The second experiment was conducted at Camp Pendleton, Oceanside California in October 1995. The sampling range was much larger for this experiment and the depth of the water column exceeded 100 m at the outlying stations. Most of the samples were collected in association with the optical mooring in 15 m of water on the 21st, 23rd, and 25th of October. The water column and optical properties were quite different on the 21st compared to the 23rd and 25th with the maximum in algal pigment concentration occurring at the surface compared to the bottom. The vertical distribution of the component optical properties was essentially uniform with depth on all three days with phytoplankton and dissolved materials being the dominant absorbers (approximately 0.05 m^{-1} for each component at 436 nm) followed by tripton (0.03 m^{-1}). The size fraction of the algal component shifted from being approximately equal contributions by the < 5 um and the >5 um diameter size fractions on the 21st compared to essentially all <5 um on the 23rd. The specific absorption coefficients increased from the 21st to the 25th consistent with a decrease in cell size. Spectral absorption coefficients were not significantly different in shape over the visible portion of the spectrum but were very different in the ultraviolet with a large absorption peak at 365 nm. On the 21st this feature was largest in the surface waters, decreasing in magnitude with depth, while on the 23rd and 25th the feature was largest at the bottom of the water column. This feature has been observed only in surface waters in the North Atlantic and North Pacific (unpublished data 1994 and 1996) suggesting that the bottom water mass observed on the 23rd and 25th may have been subducted surface waters. The variations in absorption were largest as a function of depth (σ =0.023 m^{-1} at 410 nm) due primarily to changes in the magnitude of tripton absorption, compared to cross shore variations at the surface (σ =0.007 m^{-1}) or depth averaged temporal variations (σ = 0.006 m^{-1}) which were primarily due to variations in the magnitude of the phytoplankton absorption coefficient. For the wavelengths monitored by the optical moorings, no significant changes in the component-specific absorption coefficients would be monitored, the variations over the sampled spatial and temporal scales will be due to physical conservative processes.